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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,028	06/30/2003	Junko Izumitani	239523US2	7383
22850	7590	03/22/2005	EXAMINER	
OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C.			CHEN, ERIC BRICE	
1940 DUKE STREET			ART UNIT	PAPER NUMBER
ALEXANDRIA, VA 22314			1765	

DATE MAILED: 03/22/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/608,028	IZUMITANI, JUNKO	
	Examiner	Art Unit	
	Eric B. Chen	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 6/30/03.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-5 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-5 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date <u>6/30/03</u> . | 6) <input type="checkbox"/> Other: _____ |

Handwritten mark resembling a stylized 'A' or 'H' with a diagonal line through it.

DETAILED ACTION

Priority

1. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 1-2 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjorkman et al. (U.S. Patent No. 6,340,435) in view of Winebarger et al. (U.S. Patent No. 5,478,436).
4. As to claim 1, Bjorkman discloses a manufacturing method of an electric device having a wiring connection structure, comprising steps of: (a) forming a wiring (48) on a substrate (column 8, lines 7-9; Figure 2A); (b) forming an interlayer insulating film (42/44) with covering said wiring (column 8, lines 7-9); (c) forming on an upper surface of said interlayer insulating film (42/44) a mask material (52) having a pattern that exposes a portion of said upper surface of said interlayer insulating film (42/44) above said wiring (48) (column 8, lines 34-38; Figure 2B); (d) performing an anisotropic etching with employing said mask material as an etching mask, so that said interlayer insulating

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film is removed to form a concave part, and according to this, said wiring (48) is exposed (column 8, lines 48-59; Figure 2C); (e) removing said mask material (column 8, lines 56-59); (f) forming a conductive film (60) on a structure obtained by said step (e) with filling up said concave part (column 9, lines 24-27; Figure 2H); and (g) removing said conductive film of a part which is formed on said upper surface of said interlayer insulating film (column 7, lines 25-27); and wherein in said step (d), by performing said anisotropic etching with employing a predetermined etching gas, a side wall of said concave part has a smooth shape without a microscopic unevenness in a vicinity of said upper surface of said interlayer insulating film at least (column 16, lines 55-64).

5. Bjorkman does not expressly disclose the step of: (h) cleaning a surface of a structure obtained by said step (g) with employing a cleaning solution which has the property of dissolving a material of said wiring. Winebarger teaches that after the chemical mechanical polishing (CMP) process, the planarized surface becomes contaminated with particulate matter and metals (column 1, lines 48-51). Metal contaminates readily diffuse through underlying dielectric layers, causing electrical failure of components (column 3, lines 35-44). Furthermore, caustic solutions, which are highly reactively with metals, are highly effective at removing these contaminants (column 1, line 67; column 2, lines 1-6). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include the step of: cleaning a surface of a structure obtained by said step (g) with employing a cleaning solution which has the property of dissolving a material of said wiring. One who is

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skilled in the art would be motivated to remove the layer of metallic contaminants to prevent failure of the underlying semiconductor component.

6. As to claim 2, Bjorkman discloses that the predetermined etching gas is a mixed gas of C_4H_8 , O_2 and Ar (column 8, lines 52-55).

7. Claims 3-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bjorkman, in view of Winebarger, in further view of Wolf et al., *Silicon Processing for the VLSI Era*, Vol. 1, Lattice Press (1986).

8. As to claim 3, Bjorkman does not expressly disclose that step (f) includes steps of: (f-1) forming a barrier metal film composed of a material which has solubility to said cleaning solution; and (f-2) forming a metal film on said barrier metal film, wherein in said step (d), a depth of said concave part is set to be a depth that said barrier metal film formed on a side surface of said concave part by said step (f) is not completely dissolved by a cleaning in said step (h). Winebarger further teaches that one of the drawbacks of using a chemical cleaning solution to remove metallic contaminants after chemical mechanical polishing is that the solution may react with the underlying metal wire, causing catastrophic device failure (column 2, lines 4-11). Bjorkman discloses forming a protective barrier layer (46), composed of silicon nitride or silicon carbide, over wiring (48) (column 8, lines 7-9). Wolf teaches that silicon nitride is suitable for a passivation layer because it behaves as a nearly impervious barrier layer to diffusion (page 191). Moreover, the optimal wet etching conditions (such as etching temperature) for silicon nitride and aluminum are different (page 534). Furthermore, whereas the wet etching rate of silicon nitride is about 100 Å/minute, the wet etching

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rate of aluminum is about 1000-3000 Å/minute (page 534). Therefore, it would have been obvious to one of ordinary skill in the art to the time the invention was made to include the steps of: (f-1) forming a barrier metal film composed of a material which has solubility to said cleaning solution; and (f-2) forming a metal film on said barrier metal film, wherein in said step (d), a depth of said concave part is set to be a depth that said barrier metal film formed on a side surface of said concave part by said step (f) is not completely dissolved by a cleaning in said step (h). One who is skilled in the art would be motivated to form a protective layer over the conductive film to prevent detrimental reactions with cleaning solutions and any resulting catastrophic device failure.

9. As to claim 4, Bjorkman does not expressly disclose that said wiring includes: a metal film composed of a material which has solubility to said cleaning solution; and a top layer film which is formed on said metal film and composed of a material which does not have solubility to said cleaning solution, wherein in said step (d), said anisotropic etching is stopped when said top layer film is exposed. Bjorkman discloses forming a protective barrier layer (46), composed of silicon nitride or silicon carbide, over wiring (48) (column 8, lines 7-9). Wolf teaches that silicon nitride is suitable for a passivation layer because it behaves as a nearly impervious barrier layer to diffusion (page 191). Moreover, the optimal wet etching conditions (such as etching temperature) for silicon nitride and aluminum are different (page 534). Furthermore, whereas the wet etching rate of silicon nitride is about 100 Å/minute, the wet etching rate of aluminum is about 1000-3000 Å/minute (page 534). Therefore, it would have been obvious to one of ordinary skill in the art to the time the invention was made to include steps for forming

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the wiring such that of: a metal film composed of a material which has solubility to said cleaning solution; and a top layer film which is formed on said metal film and composed of a material which does not have solubility to said cleaning solution, wherein in said step (d), said anisotropic etching is stopped when said top layer film is exposed. One who is skilled in the art would be motivated to form a protective layer over the wiring to prevent detrimental reactions with cleaning solutions and any resulting catastrophic device failure.

10. As to claim 5, Bjorkman does not expressly disclose that said wiring includes: a metal film composed of a material which has solubility to said cleaning solution; and a top layer film which is formed on said metal film and composed of a material which does not have solubility to said cleaning solution, wherein in said step (d), said anisotropic etching is stopped in process of etching said top layer film. Bjorkman discloses forming a protective barrier layer (46), composed of silicon nitride or silicon carbide, over wiring (48) (column 8, lines 7-9). Wolf teaches that silicon nitride is suitable for a passivation layer because it behaves as a nearly impervious barrier layer to diffusion (page 191). Moreover, the optimal wet etching conditions (such as etching temperature) for silicon nitride and aluminum are different (page 534). Furthermore, whereas the wet etching rate of silicon nitride is about 100 Å/minute, the wet etching rate of aluminum is about 1000-3000 Å/minute (page 534). Therefore, it would have been obvious to one of ordinary skill in the art to the time the invention was made to include steps for forming the wiring such that of: a metal film composed of a material which has solubility to said cleaning solution; and a top layer film which is formed on said metal film and composed

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of a material which does not have solubility to said cleaning solution, wherein in said step (d), said anisotropic etching is stopped when said top layer film is exposed. One who is skilled in the art would be motivated to form a protective layer over the wiring to prevent detrimental reactions with cleaning solutions and any resulting catastrophic device failure.

Conclusion

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Zhang et al. (U.S. Patent No. 6,479,443) discloses a post-chemical mechanical polishing cleaning solution for removal of metallic contaminants. Aoki (U.S. Patent No. 6,387,821) discloses forming a damascene structure by wet cleaning the via hole.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

EBC

Mar. 16, 2005

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

